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EFFECTIVE MANUFACTURING: SELECTING THE OPTIMAL FACILITY LOCATION FROM THE MULTIPLES, FOR MANUFACTURE OF EQUIPMENT USING R- METHOD: A CASE STUDY.

Mr. Rajesh Shivaji Mhetre MES Ltd, Pune Rsmhetre15@gmail.com

Introduction:

The problem of locating a manufacturing facility is there with us from a long time. Facility location refers to the location of manufacturing facilities for a particular organizational body. As competition rises and business landscape become more complex, building and keeping manufacturing facilities has become notably tougher.

A case Study:

The company is involved in handling turn-key projects of ethanol plant starting from 30klpd to 250 klpd capacities. The main responsibility is to execute various activities smoothly within stipulated time period within targeted estimated project cost by satisfying the agreement, tangible and intangible requirements of the clients.

The Present scenario is that there are 3 manufacturing facilities of the company at 3 different locations. The locations are in the radius of approximately 100 kilometers. All the facilities have their some own characteristics of production capacity, floor space area, etc. The objective of project manager is to select the best manufacturing facility (out of 3 facilities which already exist) for the production of a particular equipment, so as to optimize cost, quality and delivery time.

The equipment to be manufactured also differs in volume, weight, shape, complexity of design and manufacturing.

Objective:

The main objective is to identify and evaluate the various factors which influences, the selection of manufacturing facility (out of multiple facilities which already exist) for the production of particular equipment and then arriving at a decision of the best facility.

Methodology:

Multiple attribute decision making (MADM) is used. This method ranks different alternative facilities pertaining to different qualitative attributes and also weights of all the attributes are represented by ranks. This method is also called as R-method.

Stepwise Procedure:

Step-I

The three manufacturing facilities which exists in the district of Pune and Nagar were marked on the below map.

Step-II

The 12 subjective/qualitative attributes were identified which were affecting the decision. Since there are 3 facilities available, each of the attribute is ranked from 1 to 3scales, while 1 being the best suited option and 3 being the worst suited option for that particular attribute. I.e. floor space areas available, then we see that MF1 is best and MF2 is worst option. Hence U2 is assigned rank 1 and U3 is assigned rank 4.and U1 is assigned as 2nd rank. Same procedure is followed for other attributes.

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Table –A: Ranks assigned to the alternatives and attributes

	Attributes	Alternatives			Ranks assigned to attributes
		MF1	MF2	MF3	
A1	Manufacturing skill set availability	1	2	3	1
A2	Technical guidance	3	2	1	3
A3	Convenient for client visits	3	2	1	6
A4	Floor space area available of the plant	1	3	2	5
A5	Close to local market and vendors	1	2	3	2
A6	Testing & Inspection facility	3	2	1	10
A7	Near to Airport	3	2	1	7
A8	Raw material avaialbility in stock	3	2	1	4
A9	Safety and security	2	1	3	9
A10	Availability of lifting facility	2	3	1	11
A11	Tax benefit	3	1	2	8
A12	Efficient roads and transportation	3	1	2	12

Step-III

Each of the 12 attributes is ranked among themselves, so as to get the importance of all the factors. We see that the attribute 1 i.e. manufacturing skill set is given the rank 1 ,closeness to local market and vendors is given rank2,raw material available in stock is given rank 4,etc.While attribute A12 is of least importance. Ranking among attribute is done to give weight criteria.

The weightage given to the ranks of the alternatives /attributes are calculated up to 3 decimals and the calculation is shown as:

1/(Rank1)^-1:1/(1/1)=1.000

1/(Rank1)^-1+(Rank2)^-1:1/(1/1+1/2)=0.666

1/(Rank1)^-1+(Rank2)^-1+(Rank3)^-1: 1/(1/1+1/2+1/3)=0.545

Total=1.000+0.666+0.545=2.212

Hence,weight of rank1 = 1.000/2.212 = 0.452

Weight of rank 2 = 0.666/2.212=0.301

Weight of rank 3 =0.542/2.212 =0.247

Similarly,weights of all 12 attributes are calculated and tabulated as below.

Table-B: Weights assigned to the alternatives and attributes

	Attributes	Alternatives			Weights assigned to attributes
		MF1	MF2	MF3	
A1	Manufacturing skill set availability	0.452	0.301	0.247	0.177
A2	Technical guidance	0.247	0.301	0.452	0.097
A3	Convenient for client visits	0.247	0.301	0.452	0.072
A4	Floor space area available of the plant	0.452	0.247	0.301	0.078
A5	Close to local market and vendors	0.452	0.301	0.247	0.118
A6	Testing & Inspection facility	0.247	0.301	0.452	0.061
A7	Near to Airport	0.247	0.301	0.452	0.068
A8	Raw material avaialbility in stock	0.247	0.301	0.452	0.085
A9	Safety and security	0.301	0.452	0.247	0.063
A10	Availability of lifting facility	0.301	0.247	0.452	0.059
A11	Tax benefit	0.247	0.452	0.301	0.069
A12	Efficient roads and transportation	0.247	0.452	0.301	0.057

Step-IV:

Composite ranks and scores of the alternatives can be calculated, are given in below table-C.

For example,the composite score for MF1 is:0.452*0.177+0.247*0.097+0.247*0.072+0.452*0.078+0.452*0.118+0.247+0.061+0.247*0.068+0.247*0.085+0.301*0.063+0.301*0.059+0.247*0.069+0.247*0.057

=0.331

Table-C: Composite ranks and scores of the alternatives

Alternative	Score	Rank
MF1	0.331	2
MF2	0.323	3
MF3	0.350	1

Thus, from the score it is clear that the best decision is that a particular equipment can be manufactured in an optimum way,in facility 3(MF3).

Here, we have to note that depending upon the size, shape, weight, complexity of design of equipment, criticality of quality, etc., the ranking among the attributes will also change.Excel sheet can be used for the calculation purpose.

Conclusion:

The R-method is used to decide the facility out of 3, for optimal manufacturing of particular equipment. The ranking of facilities changes from equipment to equipment.

It is a simple ranking method that helps to navigate through the maze of alternatives and optimize the key elements that matter most. It is also suitable when there is a lack of time, qualitative characteristics is present, information is not clear and it is difficult to digest the available information. The weights obtained by this method are more accurate than other ranking methods.

As the decision is based upon linguistic assessment, a slight bias in assessment could change the result. To avoid this, an expert committee comprising of a more number of decision makers is required to evaluate each attribute against each alternative independently.